SPECIFICATION

Electronic Version 1.2.8

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[POWER SUPPLY FOR A HYBRID ELECTRIC VEHICLE]

Background of Invention

[0001] The present invention relates generally to hybrid electric vehicles, and more particularly, to a power supply for a hybrid electric vehicle.

[0002] Currently, the automotive industry is preparing to convert from a 14 volt electrical system to 42 volts to facilitate the increasing demand for electrical power. Various manufacturers of electrical components have and are currently designing 42 volt systems.

[0003] Integrated starter/motors or integrated starter/generators are also being proposed for automotive vehicles. Current plans employ the 42 volt system for the operation of the integrated starter/generators. However, during start up, low voltage and high currents can occur. The low voltage and high current may change the performance and decrease the life of electrical components within the electrical system. Components that may be adversely affected may have to be designed to be more robust. This may increase the cost of the system and the vehicle.

[0004] It would therefore be desirable to provide an electrical architecture suitable for powering an integrated starter/generator while still allowing the system to utilize current 42 volt components.

Summary of Invention

[0005] The present invention provides an improved electrical system suitable for use in a hybrid electric vehicle. The present invention provides an electrical system for an automotive vehicle having a first power source with a first positive terminal and first negative terminal. A second power source having a second positive terminal and a

second negative terminal is also provided. A common electrical node N_2 is coupled to the first negative terminal and the second positive terminal. A first load is coupled between the first positive terminal and the second node N_2. A second load is coupled between the common node N_2 and the second negative terminal.

[0006] In a further aspect of the invention, a method for operating an electrical system for an automotive vehicle comprises:

[0007] operating a first load with a first power source;

[0008] operating a second load with a second power source;

[0009] forming a series combination of said first power source and said second power source; and

[0010] operating an inverter with said series combination.

[0011] One advantage of the invention is that during cold operating conditions current draw on the system will not be as great as in a single power source system.

[0012] Other advantages and features of the present invention will become apparent when viewed in light of the detailed description of the preferred embodiment when taken in conjunction with the attached drawings and appended claims.

Brief Description of Drawings

[0013] Figure 1 is a schematic view of an electrical system for an automotive vehicle according to the present invention.

Detailed Description

[0014] The following description is provided with respect to a hybrid electrical vehicle. However, those skilled in the art will recognize that this system may be used with other types of electrical or hybrid electric vehicles.

[0015] Referring now to the figure, a hybrid electrical vehicle 10 is illustrated having an electrical system 12. Electrical system 12 has a first power source 14 having a positive terminal 16 and a negative terminal 18. Electrical system 12 also has a second power source 20 having a positive terminal 22 and a negative terminal 24. First power source

14 and second power source 20 are preferably direct current batteries generating 42 volts. Those skilled in the art, however, will recognize that various other voltages may be suitable. Also, first power source 14 and second power source 20 are illustrated as separate components. However, each of the power sources may be included physically in one box or location with three or four terminals.

[0016] First power source 14 may be coupled to a first auxiliary load 26 and second power source 20 may be coupled to power second auxiliary loads 28. Auxiliary loads 26 and 28 may be various devices and components located throughout the vehicle including power steering systems, air conditioning systems, power windows, audio equipment, heated seats, and other devices. First positive terminal 16 is coupled to a common node N_1 which in turn is coupled to one side of auxiliary load 26. Negative terminal 18 is coupled to a second node N_2. Second node N_2 is also coupled to auxiliary load 26. Node N_2 is also coupled to the positive terminal 22 of second power source 20 and auxiliary load 28. Negative terminal 24 is coupled to node N_3. Node N_3 is also coupled to auxiliary load 28.

[0017] Node N_2 may also be referred to as the chassis ground. That is, the chassis of the automobile may have its metal conducting loads electrically connected to node N_2. This allows both auxiliary load 26 and auxiliary load 28 to be operated by a single battery. Each auxiliary load 26 thus operates on a 42 volt source because the potential difference between the battery terminals is 42 volts in the present example.

[0018] An inverter 30 is coupled to the series combination of first power source 14 and second power source 20. That is, inverter 30 is coupled to node N_1 and node N_2 or the first positive terminal 16 and the second negative terminal 24. Inverter 30 is used to operate motor generator 32 that is coupled thereto. Motor generator 32 may also be referred to in the art as an integrated starter/alternator or starter/alternator. By coupling inverter 30 between nodes N_1 and N_3, inverter 30 operates on the combined voltage of power source 14 and power source 20. In the present example, inverter may thus operate on 84 volts.

[0019] In an alternative embodiment of the present invention, a switch circuit 35 having switches SW1 and SW2 and a switch controller 41 may be coupled to the circuit. Switches SW1 and SW2 open and close causing the coupling and decoupling of

auxiliary load 28 to node N_2 while closing and opening an electrical path to auxiliary load 28. That is, switch circuit 35 causes batteries 14, 20 to switch from serial to parallel which may be advantageous during certain operating conditions. Switch SW1 couples terminal 22 between chassis ground and terminal 116. Switch SW2 couples between negative terminal 24 of battery 22 to chassis ground of node N_1. In operation during a regular mode (non-motoring), switches SW1 and SW2 are shown in the solid position so that the switches are in series. Controller 41 simultaneously controls the operation of switches SW1 and SW2 By operating switches SW1 and SW2 in a non-motoring mode, first power source 14 and second power source 20 operate in parallel shown in dashed lines. That is, controller 41 senses a predetermined condition such as a non-motoring mode and operates the switches. Controller 41 controls the switching of switches simultaneously. Of course, those skilled in the art will recognize various placements and embodiments of switches will allow the changing from a series to parallel system.

[0020] While particular embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.